

NOCTURNAL HUNTING BY PEREGRINE FALCONS AT THE EMPIRE STATE BUILDING, NEW YORK CITY

ROBERT DeCANDIDO^{1,3,4} AND DEBORAH ALLEN²

ABSTRACT.—We report on nocturnal hunting by Peregrine Falcons (*Falco peregrinus*) at the Empire State Building in Manhattan, New York City. From 4 August through 13 November 2004, we saw Peregrine Falcons on 41 of 77 nights of observation. During this period, they hunted migrating birds on 25 evenings, with the first hunting attempt occurring an average of 119 min after sunset. Peregrine Falcons made 111 hunting attempts and captured 37 birds (33% success). Hunting success was highest in September, but was most often observed in October. Peregrines hunted migratory birds at night more frequently in autumn than in spring. Peregrines were significantly more likely to be present on autumn nights when >50 migrants were passing by the Empire State Building. Although the lights associated with skyscrapers are believed to disorient migrating birds and result in many bird-to-skyscraper collisions each year, Peregrine Falcons are able to take advantage of the situation. Skyscrapers provide hunting perches at altitudes often flown by nocturnal migrants, and disorientation caused by the lights sometimes results in birds circling skyscrapers and possibly becoming more vulnerable to predation by falcons. Received 26 January 2005, accepted 11 October 2005.

Several diurnal raptor species, including Black-shouldered Kite (*Elanus axillaris*), Bald Eagle (*Haliaeetus leucocephalus*), and Lesser Kestrel (*Falco naumanni*), forage at night (see Kaiser 1989, McLaughlin 1989, Negro et al. 2000). Others, such as Turkey Vulture (*Cathartes aura*), Osprey (*Pandion haliaetus*), Northern Harrier (*Circus cyaneus*), and Levant Sparrowhawk (*Accipiter brevipes*), have been observed flying or migrating at night (Tabor and McAllister 1988, Russell 1991, Yosef 2003, DeCandido et al. 2006).

Peregrine Falcons (*Falco peregrinus*) are considered nocturnal migrants in some parts of the world (Cochran 1985, Ellis et al. 1990), and they are known to hunt at night (Clunie 1976, Russell 1998). With increased numbers of peregrines nesting and wintering in cities, biologists are beginning to document nocturnal activity by these falcons in all seasons. Recently, there have been reports of urban peregrines feeding young and/or hunting at night in North America (Cade and Bird 1990, Wendt et al. 1991, Cade et al. 1996), England (Crick et al. 2003), France (Marconot 2003), Germany (Schneider and Wilden 1994, Klad-

ny 2001), Netherlands (van Dijk 2000, van Geneijgen 2000), Poland (Rejt 2000, 2001, 2004a), Hong Kong (Feare et al. 1995), and Taiwan (K. Y. Huang and L. L. Severinghaus unpubl. data). However, direct observation and analysis of nocturnal hunting by Peregrine Falcons, particularly during migration, is rare in the literature.

In New York City, New York, the number and distribution of Peregrine Falcons has changed considerably since such observations were first recorded in the late 1920s. Before the era of DDT (until 1946), from autumn through early spring, lone female peregrines were much more common at skyscrapers than males (Herbert and Herbert 1965). Peregrine Falcons rarely nested in the city, and nocturnal activity by these falcons was not reported in any season (Herbert and Herbert 1965). Beginning in the mid-1990s, however, more pairs of Peregrine Falcons have begun residing year-round in Manhattan (and the metropolitan area) than previously noted (B. A. Loucks pers. comm., C. Nadareski unpubl. data.). Today, most, if not all, of the seven pairs of peregrines that nest in Manhattan remain on territory year-round. Here, we report our observations of Peregrine Falcon activity at night during the 2004 southbound bird migration at one location in New York City.

METHODS

Most of our observations of Peregrine Falcons and nocturnal migrants occurred during

¹ Hawk Mountain Sanctuary, Acopian Center for Conservation Learning, 410 Summer Valley Rd., Orwigsburg, PA 17961, USA.

² P.O. Box 1452, Peter Stuyvesant Station, New York, NY 10009, USA.

³ Current address: 1831 Fowler Ave., The Bronx, NY 10462, USA.

⁴ Corresponding author; e-mail: rdcny@earthlink.net

the southbound migration, from 4 August to 13 November 2004; we made observations on 77 of 102 evenings during that period. In spring 2004, we observed northbound migrants on 33 evenings from 19 April through 25 May. In spring 2002, we made observations on only 2 evenings (8 May and 15 May).

We made our observations from the outside observation deck (elevation ~325 m above ground level) of the Empire State Building (ESB), located in midtown Manhattan in New York City. We arrived each evening approximately 15–30 min prior to sunset. Bird migration, on average, began 30–90 min after sunset. Any Peregrine Falcon activities defined as nocturnal occurred after nautical twilight (1 hr after sunset). We were able to conduct our study until 22:45 EST each evening (August through October) and until 23:45 in November; the observation deck of the building was closed to all visitors after these times. In spring 2004, we observed from just before sunset until 22:45 each evening, and in spring 2002, we observed from 19:00 until 21:00. During fall migration, the northwest corner of the building provided the best vantage point to count the greatest number of migrating birds, and in spring, we observed migrants from the southwest corner of the observation deck. These locations afforded unobstructed views to the horizon and the sky above. We used 10× binoculars to follow peregrines when they made long flights in pursuit of prey. It was possible to observe migrating birds and the activities of peregrines because the upper floors of the building were illuminated with (external) upward-directed halogen lights, and the spire above us was illuminated with (internal) florescent lights. We could not identify the majority of migrants to species because the external halogen lights washed out most plumage details. However, this lighting array permitted us to count migrants up to ~30–60 m above the highest point (445 m agl) of the ESB, and up to 30 m (perpendicular) from the observation deck. We estimated that the building's lights allowed us to see peregrines chasing small birds in flight up to 60–80 m distant.

Count protocols to assess nocturnal bird migration in 2004 followed those described in Bildstein and Zalles (1995) for migrating raptors. An individual was considered a migrant

if it passed south-to-north (or north-to-south) across an imaginary east-west line at the site, and continued north (or south) out of sight. On 2 evenings during southbound migration, when >100 birds simultaneously circled the ESB, we estimated the maximum number of birds circling per hour and recorded it as the number of migrants seen for that hour. We defined the peak of migration as the several-day period in which we counted the highest number of migrants. For both northbound and southbound migration, total counts presented here do not include migrating waterfowl, herons, or gulls.

We defined a hunting attempt as one in which a Peregrine Falcon approached to within 1 m of its intended prey. On a few occasions, peregrines made repeated stoops at the same prey, but did not capture or gain control of it. Each of these stoops was considered a separate hunting attempt. Several times, we observed a peregrine strike a bird but fail to seize it. We classified these as unsuccessful hunting attempts.

We defined the peak period of Peregrine Falcon activity as that during which we observed falcons at the ESB during the greatest number of consecutive nights. We used correlation statistics (Microsoft Excel 2003) to analyze data collected during this peak period. We compared (a) the time of arrival of the first migrant after sunset with the arrival of the first Peregrine Falcon, and (b) the time of arrival of the first migrant with the time of the first peregrine hunting attempt. Means are presented as \pm SD.

RESULTS

During southbound migration in 2004, we saw the first Peregrine Falcon at night on 4 August and the last one on the evening of 9 November. During this time, at least two adult peregrines (male and female), as well as immature(s), used the ESB as a hunting perch. Peregrines were seen hunting or flying at night on 53% (41 of 77) of the evenings we spent at the ESB (Table 1). Falcons were significantly more likely to be present on evenings when >50 migrants were counted in migration ($\chi^2 = 14.7$, $df = 1$, $P = 0.001$; Table 1). Of the 67 nights we observed migrating birds, peregrines hunted migrants on 25 nights (37%), made 111 hunting attempts, and cap-

TABLE 1. Summary of nocturnal hunting behavior by Peregrine Falcons in relation to the number of migrants present after sunset in autumn 2004 at the Empire State Building, New York.

	Number classes of migrant passerines						Total
	0	1-10	11-50	51-100	101-250	251+	
No. nights migrants counted	10	9	23	10	13	12	77
No. nights peregrines present	1	1	12	8	9	10	41
No. nights peregrines hunted	—	0	8	3	7	7	25
No. hunting attempts	—	0	29	17	15	50	111
No. successful hunts	—	0	8	7	8	14	37
Hunting success	—	—	28%	41%	53%	28%	33%
No. nights male observed hunting	—	0	5	2	5	6	18
No. nights female observed hunting	—	0	2	1	1	1	5
No. nights unknown sex observed hunting	—	0	1	0	1	1	3

tured prey 37 times (33% success). All of the migrants we observed being captured or chased were in the warbler-to-oriole size class.

The peak of Peregrine Falcon activity occurred from 26 September through 14 October 2004. During that time, we conducted observations on 17 nights; on 16 of those nights we observed Peregrine Falcons, and on 11 nights we observed them hunting (70 total hunts, 21 prey captures, 30% success). During this period, the first migrant birds were observed 65 ± 20 min after sunset (range = 42–114 min); Peregrine Falcons arrived 91 ± 41 min after sunset (range = 47–190 min), and made their first hunting attempt 45 ± 59 min later (range = 61–284 min), or approximately 136 min after sunset. There was no correlation between passage of the evening's first migrant and the arrival of a Peregrine Falcon at the ESB ($r^2 = 0.10$, $P = 0.73$) or between passage of the first migrant and the time of a peregrine's first hunting attempt ($r^2 = 0.15$, $P = 0.24$).

Nocturnal hunting success was greatest in September (12 of 27, 44%) and lowest in No-

vember (1 of 8, 13%; Table 2). On 10 October from 20:12 to 20:42, a male Peregrine Falcon made 25 hunting attempts and captured 9 birds (36%), caching the birds on the ESB tower after each kill. Throughout the autumn, we observed Peregrine Falcons capture only migratory birds, although a few Rock Pigeons (*Columba livia*), and at least two bat species, Little Brown (*Myotis lucifugus*) and Red (*Lasiurus borealis*) bats, were present on some evenings. We could identify only two prey species: a Baltimore Oriole (*Icterus galbula*) captured on 23 August, and a Yellow-billed Cuckoo (*Coccyzus americanus*) taken on 9 October. On 3 and 9 November, despite high numbers of American Woodcocks (*Scolopax minor*) migrating past the ESB tower (36 counted each night), no peregrines were observed.

In autumn 2004, most bird migration occurred at eye-level and above the observation deck. We counted 10,826 migrating birds, and the peak of the migration occurred from 5 to 11 October when 3,871 migrants (36% of the

TABLE 2. Summary of nocturnal hunting behavior and success by Peregrine Falcons during four autumn months in 2004 at the Empire State Building, New York.

	Aug	Sep	Oct	Nov	Total
No. hunting attempts	16	27	60	8	111
No. successful hunts	6	12	18	1	37
Hunting success	38%	44%	30%	13%	33%
No. nights one peregrine present	10	11	10	3	34
No. nights ≥ 2 peregrines present	0	3	4	0	7
No. nights hunting observed	5	9	10	1	25
No. nights male made a hunting attempt	5	7	5	1	18
No. nights female made a hunting attempt	0	2	3	0	5
No. nights unknown sex made a hunting attempt	—	1	2	—	3

fall flight) were counted, averaging 114 birds/hr on these 7 evenings. In spring 2004, we counted 3,359 migrants during 33 nights of observation. The peak of the migration occurred from 6 to 15 May when 1,752 migrants (52% of the spring flight) were counted, averaging 51 birds/hr on these 10 evenings. Lone Peregrine Falcons were observed on 2 evenings: 24 April (0 migrants counted) and 22 May (79 counted), but no hunting attempts were observed on either night. On 15 May 2002, we observed an adult female peregrine make 10 unsuccessful hunting attempts on migrants from 20:15 until 21:00.

In the breeding season of 2004, a pair of Peregrine Falcons may have attempted to nest on the ESB (B. A. Loucks pers. comm.). It is possible that this pair executed many of the hunting attempts we observed in autumn 2004. During 5 evenings between 26 September and 7 October, we saw an adult male and an adult female peregrine perched near one another, each vocalizing with the "eechup" or "creaking" call, and the "wailing" calls (see Ratcliffe 1980). On 3 October, we observed three adults (a male, his mate, and a second female) perched for <5 min within ~20 m of one another on the ESB tower until the second female was chased away—mostly by the female of the pair. An immature peregrine was present on 3 evenings: 9 and 14 October, and 9 November 2004, although we could not be sure if it was the same bird on all 3 evenings. On 5 October, a Peregrine Falcon passed high overhead flying south on moderate northerly winds while an adult female flew back and forth near the ESB. It was not uncommon to see peregrines flying high above (25–75 m) the top of the ESB tower at night in September and October.

DISCUSSION

Tall, lighted, man-made structures present opportunities for biologists to study nocturnal hunting by Peregrine Falcons that may not be observed readily in remote locations. Urban skyscrapers provide hunting platforms that permit these raptors to perch at or above the elevation of nocturnal migrants, and the lights used to illuminate tall buildings can disorient migrating birds that may then circle these structures, especially on evenings with overcast skies and light winds. These migrants

constitute an abundant, easily accessible resource for resident Peregrine Falcons, and for peregrines migrating through the area as well.

In New York City in 2004, Peregrine Falcons were more likely to be present and hunting at the ESB on autumn nights when >50 migrants were observed. The peak of peregrine activity at the ESB corresponded to the peak of the southbound bird migration from late September through mid-October. During this time, two adult peregrines occasionally perched near one another and used the ESB as a hunting platform. More night migrants were attracted to the building's lights during autumn rather than spring migration, and many more circled the tower for longer time periods from August through late October. In spring, there are fewer nocturnal migrants, and these mostly pass higher above New York City on warm air currents that override heavier, cooler air near the ground (see Kerlinger and Moore 1989). Each of these factors likely influences a peregrine's decision to hunt migrants more frequently at night during autumn. On the only spring night (15 May 2002) during which we did see several peregrine hunting attempts, winds were ~24–32 km/hr from the northwest, and many migrants passed at or just above the level of the observation deck.

Peregrine Falcons hunted migrants in two ways: pursuit and "still hunting" (*sensu* Cade 1982). At the ESB, greater success occurred when they pursued prey in level flight from behind; however, peregrines more often employed still hunting from a west- or north-facing perch on the spire above the observation deck. When still hunting, they launched their attacks at a 5 to 15° angle down toward incoming migrants flying along a northwest-to-southwest route past the ESB. Such direct attacks were often unsuccessful, and peregrines had to make additional short stoops to secure the prey. If the intended prey was able to dodge the initial attack, it would then fly straight down toward the ground, and peregrines often made no further pursuits. We never observed targeted prey attempt to escape by "ringing up," nor did we ever observe birds mass together in a flock when a Peregrine Falcon flew among them. On some nights (e.g., 10 October), when many migrants passed the ESB and peregrines captured several birds, we

also observed unsuccessful hunting attempts that were considerably less intense than others made on the same evening. Such behavior may account for the low hunting success rate on nights when >250 migrants were counted.

As camera use increases for 24-hr nest surveillance, it may become possible to determine whether Peregrine Falcons frequently hunt at night during the nesting season, and whether this varies from year to year (see Rejt 2004b). Future studies at the ESB may also determine whether nocturnal flights made toward conspecifics are directed at neighboring Peregrine Falcons or at night-migrating falcons simply passing through the area.

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